

Now from the diagram it will be seen that $\angle CE'A = \angle CPE = \theta$, say, and $EP = E'A = r$. The attraction due to E at P is equal to $k\sigma dS \cos \theta$, but this is clearly, if $r = EP$,

$$k\sigma \frac{a^2 dS' \cos \theta}{f^2 r^2}.$$

Now the factor $dS' \cos \theta / r^2$ is clearly the solid angle subtended at A by the element dS' . The whole force exerted at P by the shell is thus, to a constant factor, equal to the solid angle subtended at A by the whole concentric surface of radius f , which is 4π . The attraction of the shell on a unit particle at P is thus $k4\pi\sigma a^2/f^2$, that is, it is the same as it would be if the whole mass were collected at the centre.

If the point P be internal to the shell the concentric surface with A falls within, and the total solid angle subtended by the shell at A is zero so that the attraction is zero.

This process extended to an ellipsoid and the confocal ellipsoid through an external point is made to give the force due to the shell at the point. The integration is made immediate by the use of a theorem of solid geometry which holds, as I pointed out, for confocal conicoids. The theorem may be stated here. Let A and P, E and E' be pairs of corresponding points; then the distances AE' and PE are equal, also if p and p' be the lengths of the perpendiculars from the centre on P and E', θ the angle which PE makes with the perpendicular p , θ' the angle which E'A makes with the perpendicular p' , then the theorem holds—

$$\frac{p}{\cos \theta} = \frac{p'}{\cos \theta'}.$$

This theorem shows the result of the integration over the ellipsoid to be, to a constant, equal to the solid angle subtended at an internal point by a closed surface in the manner just illustrated by the spherical shell. It is curious that this geometrical theorem which enables this result to be obtained is, as I have found, generally unknown to writers on geometry, and is not contained in any of the treatises which I have examined.

The next problem is one of which, I believe, the only simple solution given before 1900, was due to the late Prof. Tait, of Edinburgh. The problem was the determination of the pull between the two halves of a homogeneous sphere due to gravitational attraction. Prof. Tait's solution was a quasi-hydrostatic one, and I believe that he held the opinion that the only choice was between this and straightforward sextuple integration. There are, however, at least three other methods of attacking the problem, and one of these which occurred to me a long time ago I will indicate here. This has only been published so far as I know in a collection of exercises lithographed nearly twenty years ago by the late Dr. Walter Stewart, who was then my assistant, for the use of students in Glasgow. It makes use of the theorem of Gauss referred to above.

Consider the homogeneous sphere of radius a and let a closed surface be described consisting of a plane part dividing the sphere into two segments, and a spherical part fitting close to the smaller segment of the sphere. The surface integral of normal force over this surface will consist of two parts, I, the integral over the plane, and Σ the integral over the spherical portion. The mass M of the enclosed segment can easily be calculated and $4\pi kM$ is equal to $I + \Sigma$; of course Σ is also easily calculated, and thus I is obtained. If r be the radius of the plane section, z the distance of that section from the centre, ρ the density of the sphere, the mass of unit area of a disc of radius r and thickness dz is ρdz . Multiplying this by I, we see that

the product $I\rho dz$ is the force due to the whole sphere on the disc of radius r and thickness dz , and if this be integrated from $z=a$ to $z=0$ we obtain the attraction of the whole sphere on the hemisphere throughout which the integration has been carried; this attraction of the whole sphere on the hemisphere includes the attraction of this hemisphere on itself, which, of course, is zero. Thus the integration gives the attraction of one hemisphere by the other.

The mass M of the segment within the closed surface is easily seen to be

$$\frac{1}{3}\pi\rho(2a^3 - 3a^2z + z^3);$$

the integral of normal force over the curved part of this segment is

$$\Sigma = 2\pi k a^2 \left(1 - \frac{z}{a}\right) 4\pi a \rho;$$

thus

$$I + \frac{8}{3}k\rho\pi^2 a^3 \left(1 - \frac{z}{a}\right) = \frac{4}{3}k\rho\pi^2 (2a^3 - 3a^2z + z^3),$$

that is

$$I = \frac{4}{3}k\rho\pi^2 z(z^2 - a^2).$$

We have therefore for the product of I by the mass per unit area of the disc coinciding with the plane surface of the segment

$$I\rho dz = \frac{4}{3}k\rho^2\pi^2 z(z^2 - a^2) dz.$$

Integrating from $z=a$ to $z=0$ we get for the pull P on one hemisphere exerted by the other,

$$P = \frac{1}{3}k\rho^2\pi^2 a^4,$$

or $3kM^2/16a^2$, where M is the mass of the sphere supposed of uniform density ρ .

A numerical estimate of P for the earth must be very rough, for the earth is not of uniform density, and there are other causes of inexactitude. But by the formula an estimate can be made in any units that may be preferred. In c.g.s. units k is 6.7×10^{-8} . The force between the two hemispheres of a body of such great dimensions as the earth must be almost entirely due to gravitational attraction (for cohesion must be negligible in comparison), and this figure may be taken as giving an idea of its amount.

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The Conquest of Malaria.

THE obituary notice of Sir Patrick Manson, in NATURE of May 6, concludes with the hope that his memory may ever be kept alive as the Father of Tropical Medicine. As to this it is not difficult to forecast that the medical profession will fully concur. To the enthusiasm and inspiring teaching of Manson is due the existence of tropical medicine as a speciality, and the ever extending benefit tropical races receive at the hands of men trained on the lines indicated by him.

In the present day, the views of the medical profession are apt to change rapidly in accord with accumulated investigations and experiences of world-wide origin; opinions rigidly adhered to for fifty years may be rendered taboo by a single telegram received from some expert at a remote corner of the earth. If the new view stands the test of criticism the practical results are grasped; but few care to memorise how the change was effected. If this be so with the profession specially concerned with disease

prevention, it is not surprising to find that certain lay journals, in their biographical notes of Sir Patrick Manson, have given erroneous views of his connection with malaria prevention. Although, obviously, the well-informed writer of the obituary notice in your columns has no such intention, it seems to me that his quotation from NATURE (Vol. 61, 1900, p. 523) of matter by Sir Ronald Ross, unless considered side by side with other historical facts, is liable to accentuate the popular assumption that Ross, having been instructed by Manson as to what he would find in the mosquito, forthwith¹ performed the necessary harakiri—and the key to the etiology of malaria was found; and, therefore, to Manson and not to Ross is due the credit of the epoch-making discovery of malaria transmission. Yet Manson, with no less courtesy and frankness than displayed by Ross in elevating (in the matter quoted by your writer) what Manson himself termed a hypothesis to the rank of an induction, expressly disavowed any such claim.

In thus acting, Manson was fully aware of the great value to the British Empire and the world generally of the solution of the malaria problem which had been secured by Ross. In his paper read before the Royal Institute of Public Health Congress at Aberdeen, in 1900, he said: "I feel safe in asserting that malaria is far and away the most important of the many problems of tropical empire—that empire on which so much of our present and of our prospective national prosperity depends. The politician and the soldier may not think so. They are wrong. Such people habitually magnify their offices. . . . Our little wars and rebellions in their effects and importance are insignificant in comparison to the great natural phenomena, disease—to malaria for example." "My purpose . . . is to state . . . the . . . leading facts of the new knowledge which dawned only some twenty years ago with the discovery by Laveran of the cause and nature of malaria, and which culminated only two years ago when our countryman Ross showed how the infection is acquired, and in doing so clearly indicated in what way it is to be prevented."

To understand Manson's position it is necessary to indicate what was the actual "induction" he placed at the disposal of Ross. The following is found at pp. 16 and 17 of the first edition of "Tropical Diseases," by Manson: "I consider that the flagella—which as already stated are to be regarded as flagellated spores (*sic*)—are endowed . . . with locomotive powers, in order that they may be able to pass from the blood in the mosquito's stomach to the tissues of the insect. . . . The plasmodium, I hold, is an intracellular parasite both outside as well as inside the human body, and that when outside the human body it is parasitic in the mosquito. . . . The mosquito generally dies in the water beside the eggs she has deposited. When the eggs are hatched the young larvæ commonly devour the body of the parent and consequently her parasites. On the infected larvæ becoming mature insects the plasmodia they have swallowed continue, I conjecture, to develop. These insects, in their turn, infect their larvæ and so on. . . . *Man, I conjecture, may become infected by drinking water contaminated by the mosquito; or, and much more frequently, by inhaling the dust of the mud of dried-up mosquito pools; or in some similar way.*" (Italics not in original.)

Whilst, then, it is true Manson's induction of 1894 strengthened the hypotheses of Dr. A. F. A. King and Laveran as to mosquito agency, and this resulted in an inquiry by Ross as to possible extra-corporeal existence of the plasmodium, it is equally true that

the work of Ross proved Manson's theories in essential details incorrect and misleading.

Holding in mind the Manson hypothesis, as stated by himself, if the quotation used by your writer be placed side by side with Manson's disavowal, it is not apparent there was any intention of Ross to say more than that the Manson hypothesis proved an incentive to action, and that in its absence it is probable research on the subject would have lapsed:

Ross.

(Vol. 61, 1900, p. 523.)

"I have no hesitation in saying it was Manson's theory, and no other, which actually solved the problem; and, to be frank, I am equally certain that but for Manson's theory the problem would have remained unsolved at the present day."

MANSON.

("Tropical Diseases," ed. 1900, p. 21.)

"Thus by direct observation and analogy Ross distinctly, and first, proved that the extra-corporeal phase of the malaria parasite is passed in particular species of mosquitoes, and, by analogy, that the parasite is transferred from man to man by the mosquito." (Italics not in the original.)

It need not be said that sanitary efforts based upon the mosquito contamination water theory of Manson could have secured no conquest of malaria.

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Transcription of Russian Names.

THE system for transcribing Russian names advocated by Dr. Bohuslav Brauner in the issue of NATURE for April 29, namely, by the adoption of a few letters from the Bohemian alphabet, is open to serious objection.

In the first place, Bohemian is not the only Slavonic "State-tongue of an independent State." If Russian is to be transcribed into Latin characters as used by Slavs, the obvious model is Serbo-Croatian, which employs both Cyrillic and Latin characters, with regular rules for transcription. The Bohemian and Croatian alphabets are by no means identical; for instance, *ch*, which has in Bohemian the same sound as in German and Gaelic, would convey to a Croat some such sound as *tskh*; and he would not recognise some of the Bohemian letters bearing diacritical marks.

But if we are trying to abolish the Germanised and Gallicised forms of Russian names, why substitute another foreign form? These Slavonic letters with the diacritical marks are as unfamiliar to the ordinary Briton as the Cyrillic letters themselves,—*vide* Dr. Brauner's examples; and from this follows a practical difficulty in adopting his system in this country, namely, that very few printing presses and certainly no linotype machines have the necessary type, and the cost of introducing it would be prohibitive. Thus Dr. Brauner's "advantage of a great economy in printing" is outweighed by the disadvantage of impracticability in printing.

There is no reason why Russian personal names should not fall into line with Russian place-names, many of both being identical. And for Russian place-names the Permanent Committee on Geographical Names for British Official Use has adopted the system that has been in use for many years at the War Office, and also, except in one or two particulars, at the Admiralty. This is a system of transcription without the use of diacritical marks, which are undesirable in maps; the vowels have Italian values (e.g. *e, i, u*), and the consonants English values (e.g. *ch, sh, y*), the only exception being *j* which has the French value and is preferable to the un-English *zh* for this sound. If

¹ Unaided by public funds, Ross devoted years of laborious experiments to the solution of the problem.